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VLCC 'METULA' OIL SPILL

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Texas A and M Research Foundation

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16. Abstract

On 9 August 1974, the METULA, a 206,000 deadweight VLCC (Very Large Crude Carrier) enroute from Ras Tenura, Saudi Arabia to Quintera Bay, Chile with a load of 195,673 tons of Arabia light crude, ran aground on the Satellite Patch Shoal in the Straits of Magellan, Chile. The author was detailed by the U. S. Coast Guard to proceed to the spill site to serve in the capacity of Science Advisor to the U. S. National Strike Force sent to assist the Chilean government abate the spill. This report summarizes:

a. History of the Spill
b. Deposition of Oil on the Shore
c. Impact of the Oil on the Shore
d. Comments regarding Feasibility of Containment, Cleanup or Stabilization.

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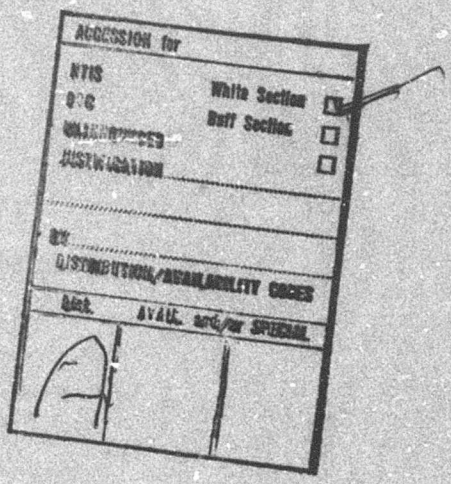

ACKNOWLEDGEMENTS

The author of the report was deeply grateful to the many people who helped make this trip a success. The author thanks Admiral Eduardo Allen of the Chilean Navy for his interest, help and hospitality; to the administration and staff of the Instituto de la Patagonia for the invitation to participate in their field program; and to Commander James Atkinson of the U.S. Coast Guard for his coordinating activities. Dr. Jon Wonhom of the English Warren Springs Laboratory provided valuable counseling and assistance.

The author is particularly indebted to his wife, Ann, for her support in undertaking the trip and her excellent endeavors with regard to the arrival of their daughter, Karen Bea, while he was in Chile.

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SECTION I. INTRODUCTION

This report was prepared by the author following a trip to southern Chile at the request of the United States Coast Guard to serve in the capacity of Science Advisor to the National Strike Force sent to assist the Chilean government with regard to the grounding of the VLCC (Very Large Crude Carrier) METULA.

This report primarily contains information obtained during the trip with some supplemental information provided that has been learned after returning to the United States.

History of the Spill

The following description of the incident and spill was obtained by the author from a variety of verbal and published sources. It should not be considered as a formal and complete accounting of the entire incident, but is presented here as the author's best knowledge of the incident, to provide background information necessary to the reader.

The METULA is a VLCC of 206,000 dead weight tons, 1,067 feet long, which is owned by the Curacao Scheepvaart Maatschappij, a company of the Royal Dutch Shell group and managed by Shell Tankers BV Rotterdam.

On August 9, 1974 the METULA was enroute from Ras Tenura Saudia Arabia to Quintera Bay Chile with a load of 195,673 tons

of Arabia light crude. At 10:18 p.m. on August 9, 1974 the METULA ran aground on the Satellite Patch Shoal immediately west of the First Narrows in the Straits of Magellan at approximately latitude 52 34 00 south and longitude 69 40 48 west.

The location of the site of the grounding of the tanker METULA is shown on the general map of the Straits of Magellan (Figure 1) and in the detailed map of the Bay of Felipe and the First Narrows area in Figure 2.

Figure 3 is a photograph of the METULA taken on August 28, 1974.

Figure 4 is a photograph taken on the same day which shows the grounded METULA and streaks of oil spreading away from the METULA.

Figure 4 also shows a rough diagram of the tank layout of the METULA.

The METULA was reported to have stopped within the length of the ship with the water depth at the forward ballast tank being 43 feet whereas the depth of the ship before grounding was estimated to be 58 feet 6 inches. Estimates placed initial oil loss around 6,000 tons. Initial damage was reported to the forward most cargo tanks.

During the evening of the night of August 11, the tanker was reported to have swiveled stern to starboard and the engine room double bottom was pierced causing the vessel to lose all power and electricity.

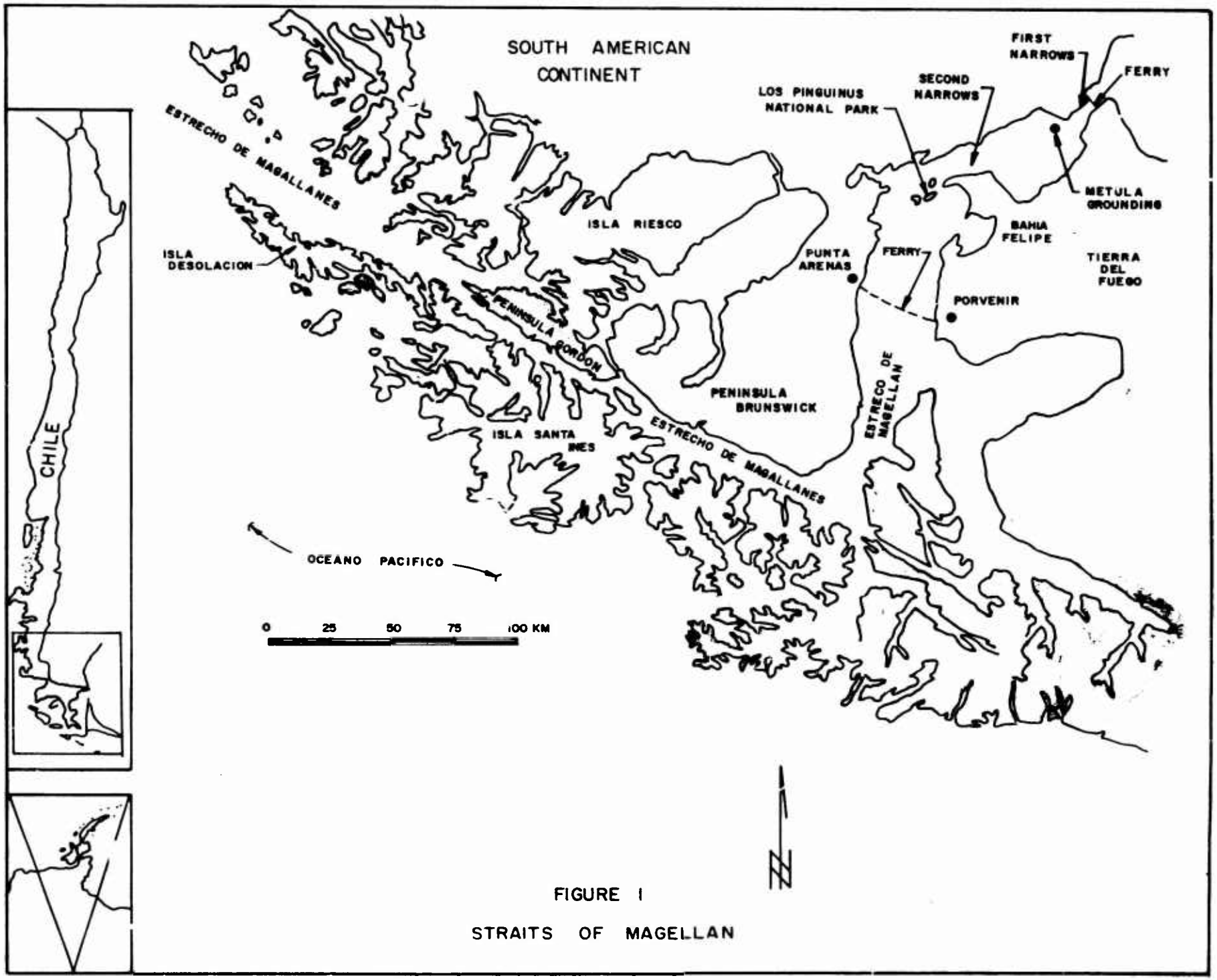


FIGURE 1

STRAITS OF MAGELLAN

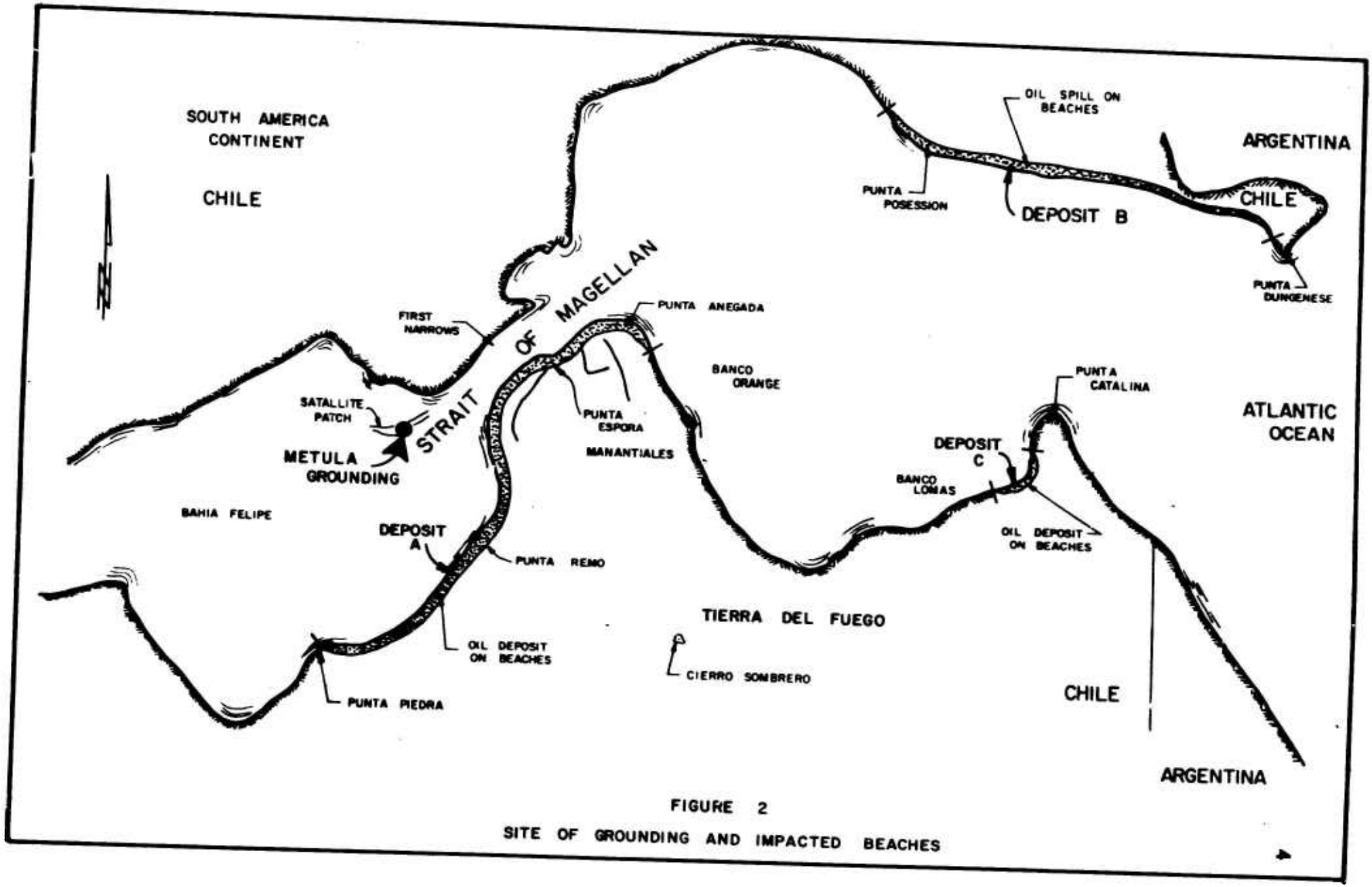


FIGURE 2

SITE OF GROUNDING AND IMPACTED BEACHES

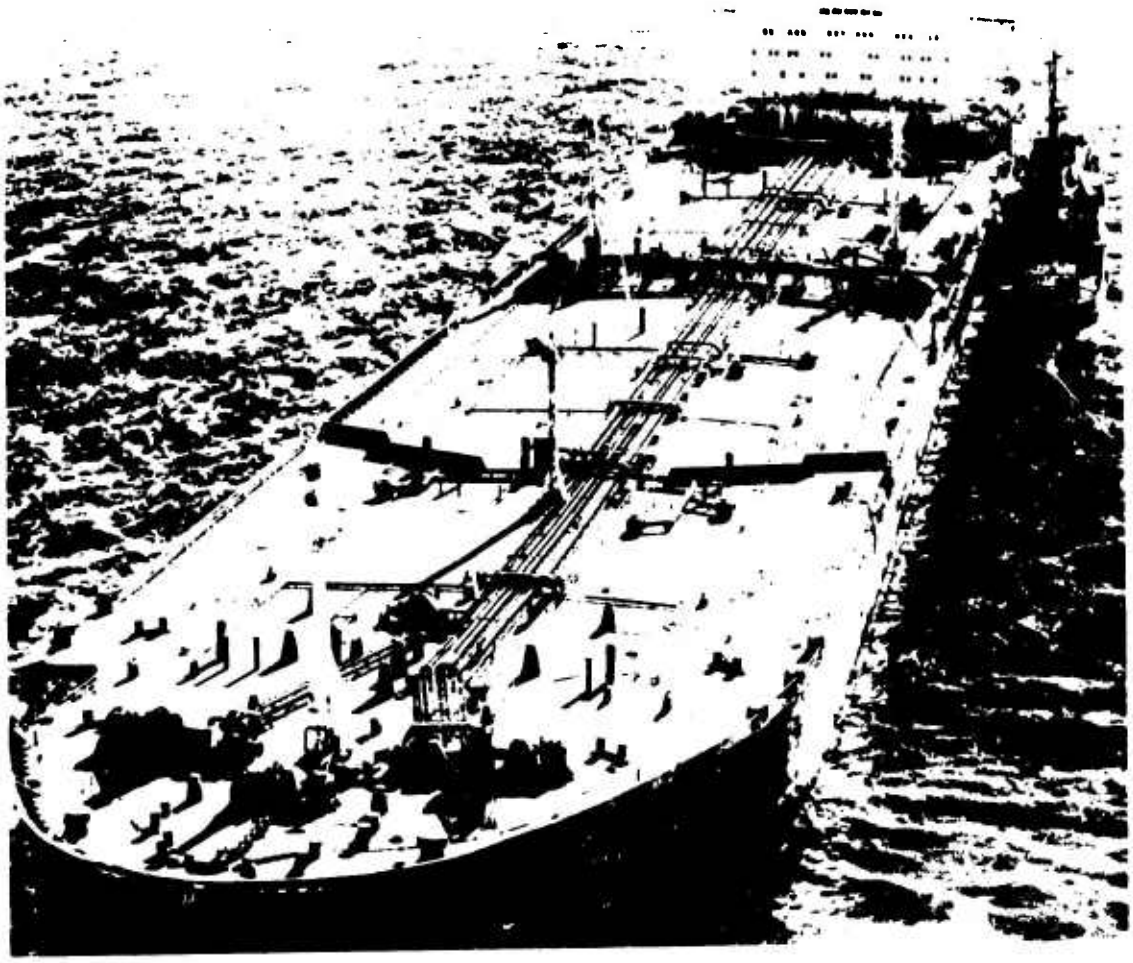
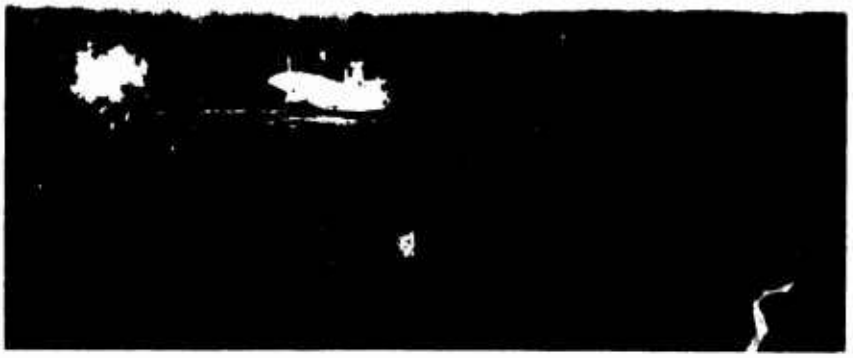


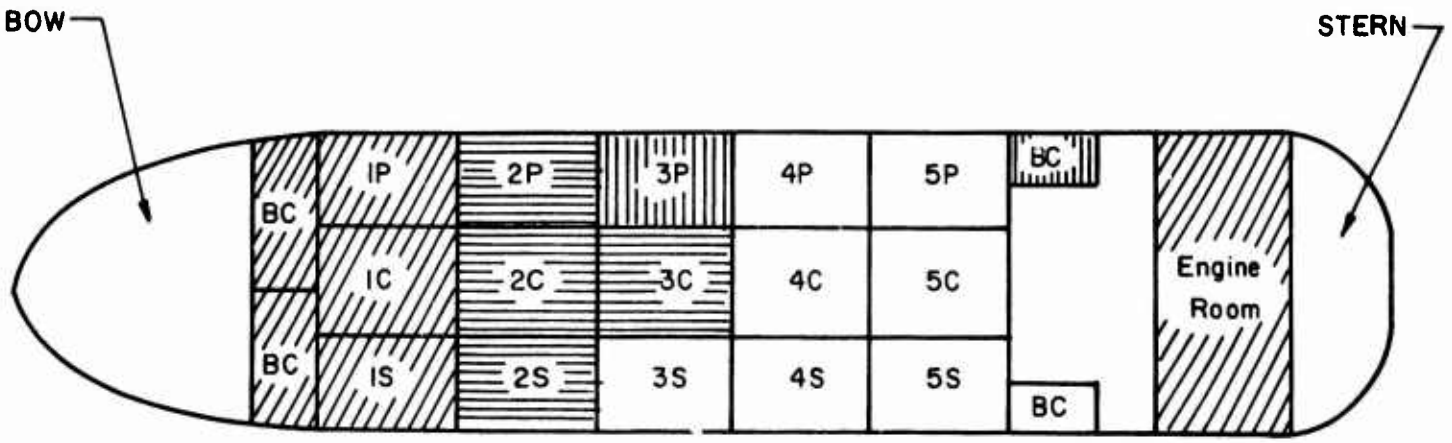
FIGURE 3

M/V METULA



P - PORT
C - CENTER
S - STARBOARD
BC - BUNKER C

- INITIAL DAMAGE 8/9 - 8/11/74
- DAMAGE SPRING TIDE 8/19 - 20/74
- DAMAGE SPRING TIDE 9/1 - 2/74



METULA TANK LAYOUT

FIGURE 4

METULA & OIL SLICK

By August 15, it had been estimated that 20,000 tons had been lost. On or about August 19, additional damage occurred and the second row of cargo tanks, two port, two center, two starboard and three center were reported as being open to the sea, either through the bottom or through piping connections, and additional losses were reported. As of August 22, it had been estimated that 40,000 tons of oil had been lost. On August 29, the small tanker HARVELLA of 19,000 dead weight tons was brought alongside and the initial pumping of oil from the METULA was carried out as part of the attempt to minimize pollution and to remove sufficient oil to float the ship. An initial load of about 15,000 tons was removed and unloading suspended until the next period of low tide range.

During September approximately 50,000 tons of oil were ultimately transferred to the HARVELLA and subsequently to the tanker BERGLAND, a tanker of approximately 96,000 dead weight tons, for transport to central Chile. The METULA was subsequently refloated at 2:20 a.m. on September 25, 1974 and moved approximately ten miles west to a safer anchorage for the rest of the oil to be pumped off.

Details of Trip

The author was contacted on the afternoon of August 23 and asked to proceed to Chile under the title of Science Advisor to the U.S. Coast Guard National Strike Force being assembled to

aid in the prevention of pollution by offloading remaining oil from the tanker METULA. The duties of the Science Advisor were specified as: (a) observing the offloading, salvage and cleanup operations, if any of the M/V METULA's grounding and resulting oil spill, (b) observing the behavior and effects of the oil spill, (c) observing the nature of the oil spill and the vast current environment, (d) taking photographs as appropriate, and (e) preparing and submitting a detailed report summarizing the observations and conclusions in the METULA oil spill.

The author departed Houston, Texas on August 24, 1974 and arrived in Punta Arenas on Monday morning, August 26, 1974. It was soon learned that the high winds and currents in the vicinity of the METULA plus the remoteness of the location had led to decisions to not attempt any containment at sea or to use any chemical agents as of that time. Furthermore, the extremely crowded conditions aboard the METULA and the difficulty of obtaining transport to the METULA and back made it impractical for the author to actually go on board the METULA.

As the result of the above factors it was decided to emphasize the evaluation, behavior and effects of the oil spill. During the first day in Punta Arenas, the author became acquainted with Dr. Jon Wonhom who had been dispatched from the English Warren Springs Laboratory as a consultant to IMCO, to serve as an international contribution to the METULA problem and Mr. Claudio Venegas, a biologist with the local Instituto de la Patagonia. Following

meetings with the staff of the Instituto de la Patagonia and the flyover of the impacted area, it was determined that a field program on the northern shore of Tierra del Fuego would be extremely valuable. As of that time, no detailed scientific survey of the status of the oil on the beach or its impact on marine life and waterfowl had been attempted.

On the 29th of August a team composed of the author, Dr. Jon Wonhom, Mr. Claudio Venegas and Jean and Bill Texera, a Peace Corp couple assigned to the Instituto de la Patagonia, departed from Punta Arenas via an Instituto de la Patagonia Landrover to carry out the field study. Over the next six days, approximately three and one half days were spent either walking the impacted beach or observing the effect of the wind and weather on the oil on the beach.

A detailed accounting of the field survey is presented in the following sections and in the chronological accounting of the trip in Appendix 2.

Following the field survey, which included observation of the spring tide cycle on the oil on the beach, an additional aerial survey was made aboard a Chilean Naval Aircraft and reports covering the observations of the aerial flights and field survey were made to the on-scene Coast Guard Coordinator, Admiral Eduardo Allen of the Chilean Navy, United States Ambassador Popper in Santiago and Captain Poisson of the Chilean Navy in Santiago.

After returning to the United States, the author participated in a formal press conference at Coast Guard Headquarters in Washington and made presentations of the incident to Shell Oil Company staff in Houston, Texas and to a seminar on the Texas A&M University campus. The author also provided information to a large number of interested scientists and newspaper reporters, including representatives of the Wall Street Journal, the Associated Press, the New Orleans Time Picayune, the Seattle Times and the Smithsonian Institute, as well as providing information, upon request, to the Office of Senator Gaylord Nelson.

Report Format

The following sections of the report will describe the physical deposition of the oil on the coastline of the Island of Tierra del Fuego and the southshore of the South American Continent; will describe the nature and characteristics of the oil on the shore and the impact of the oil on marine organisms and waterfowl; will cover some details regarding the feasibility of containment, cleanup and stabilization; and will attempt to summarize the importance of what was observed in Chile in regard to the METULA in terms of significance to United States problems.

SECTION II. DEPOSITION OF OIL ON THE SHORE

The oil which left the METULA was rapidly spread by the currents and by normal gravity spreading after release. It was reported by Commander Atkinson (USCG) that on August 20 some 1,000 square miles was observed to be covered with oil slick and on the two flights made by the author, slicks surfacing from the ship were evident in both Bay Felipe and the Bay east of the Narrows. The surface slicks, however, were much more evident on the flight on September 5 than they were on the initial flight over on August 28.

The part of the Straits of Magellan is noted for its exceptional high winds, predominantly from the west, and these winds tended to rapidly drive the oil ashore. The winds during August were such that essentially all of the oil that did not violatilize or absorb into the water column was driven onto the north shore of the Island of Tierra del Fuego. This deposition is shown on Figures 2 and Figure 5. This initial deposition covered between 40 and 50 miles of coast line.

During the field operation some 25 miles of this beach was walked by two person teams of the field party and estimates were made of the amount of oil on the beach. The beach deposits were generally described as being between 50 and 200 feet wide with a depth of from one to four inches. Figure 5 shows the specific zones walked by the different teams during the two days of intensive field study and shows the station numbering system used to describe the estimate of oil on following figures. The distances shown are

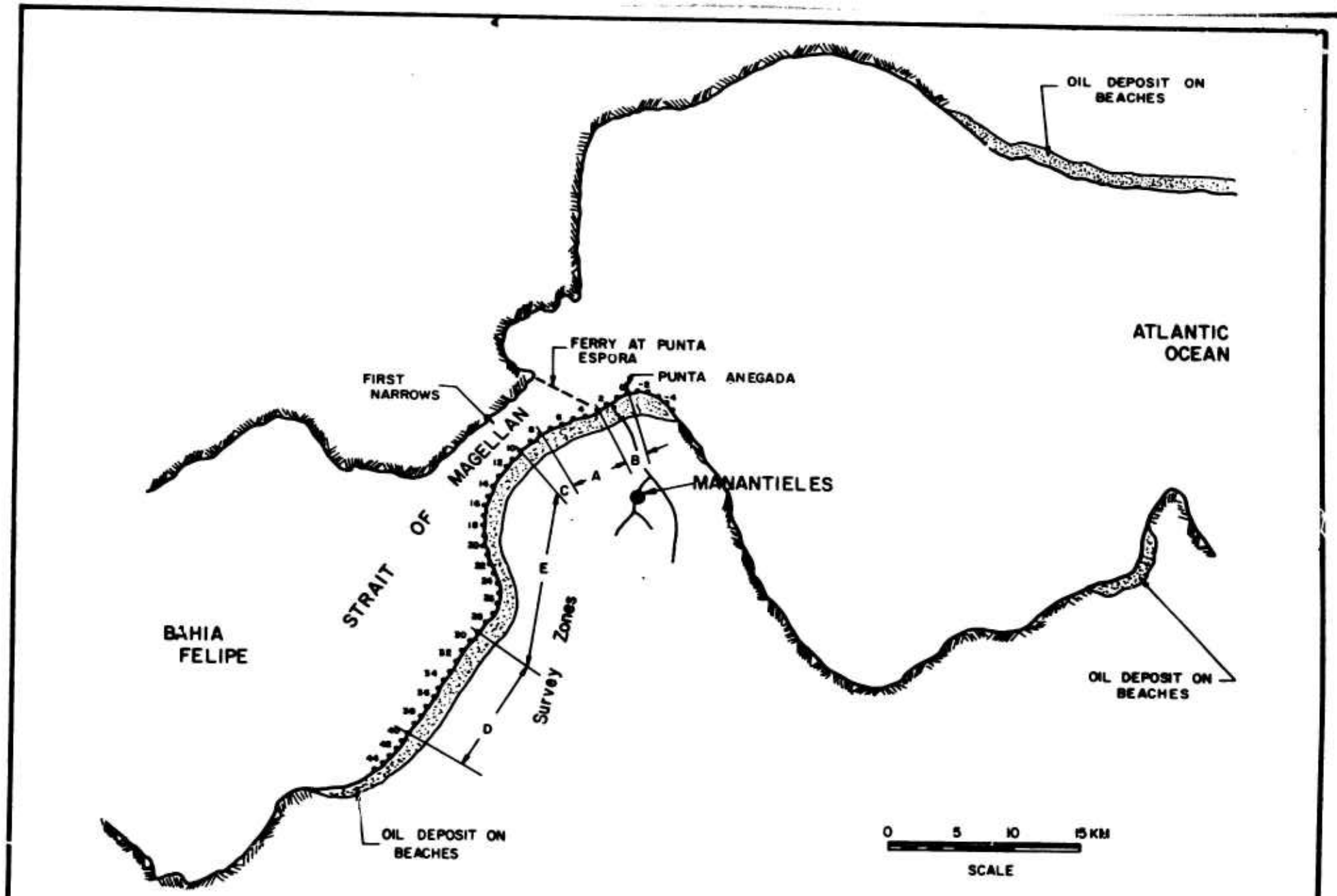


FIGURE 5

FIELD PROGRAM STATIONING AND ZONES COVERED

scaled distances from Point Anegada at the eastern end of the First Narrows. Stationing westerly of that point are indicated as plus values and easterly as negative values. The total accumulation of oil as cross sectional square feet, i.e. the width of the deposit perpendicular to the shore times the depth of the oil, is shown in Figure 6.

The oil deposit appeared as two distinct layers or bands. One was a dark brown mousse, which could be described as a dark chocolate pudding, which had been deposited above the previous spring high tide mark by the strong winds. This material was later evaluated to have a 5% moisture content and was mixed with sand particles, seaweed, marine worms and other materials picked up in its transport to the beach and which had been blown into the oil while on the beach. In a few cases, this darker deposit had been completely covered by the blowing sand which would dry out on the shore during the periods of low tides and high winds and they blow onto the oil deposits. This phenomenon was demonstrated in some of the color slides taken during the trip.

The second band consisted of a light brown mousse, very similar to milk chocolate pudding in color and texture and seemingly to behave like taffy when mixed with water in that it stayed in long, stringy bands. Both the light brown and dark brown deposits behaved quite differently from fresh oil in that it tended to stay together. It could be easily shoveled, with the depth of the oil on the shovel of about three inches deep, and when shoveled, the material

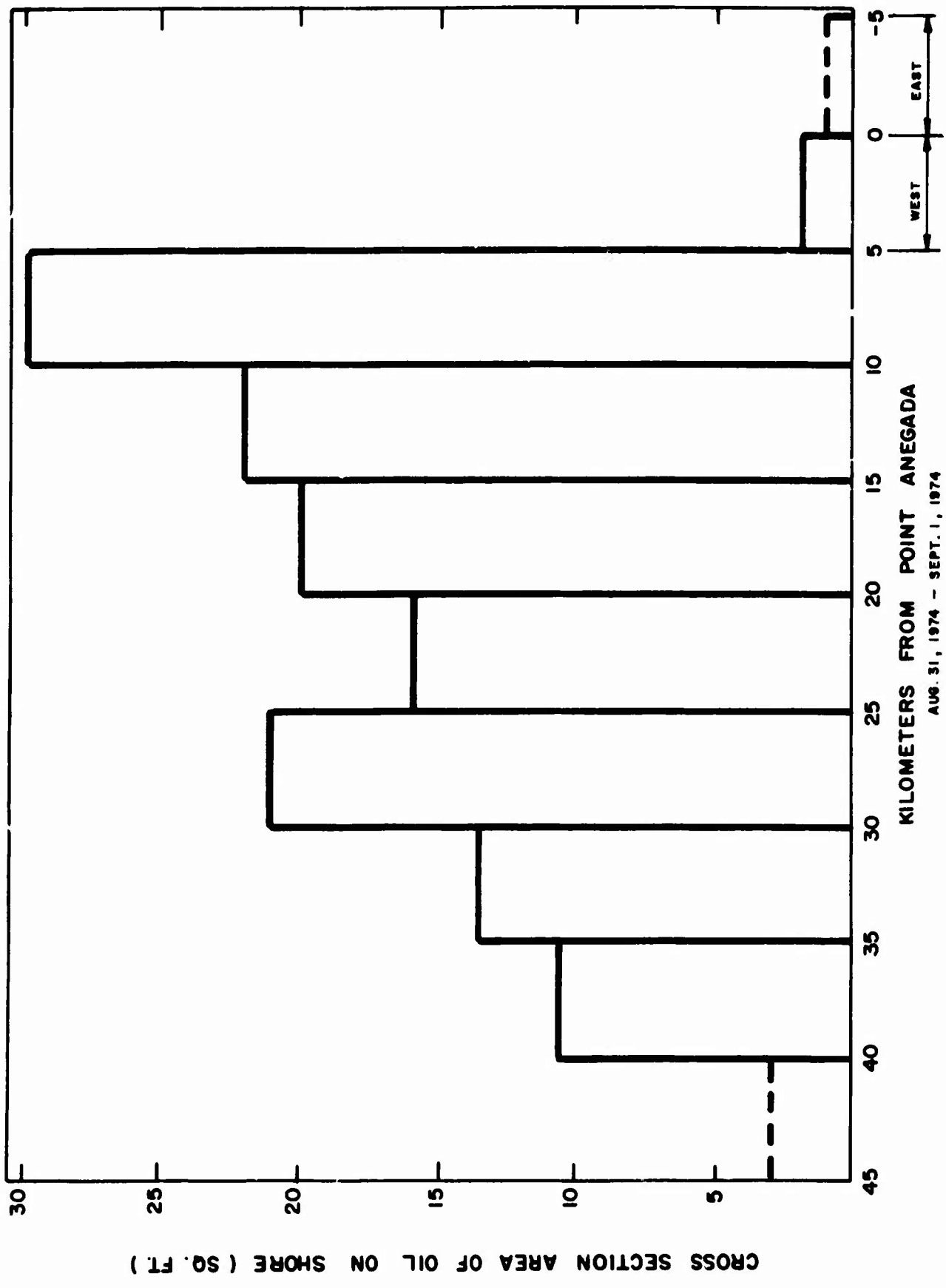


FIGURE 6

ESTIMATE OF OIL ON SHORE

had sufficient water content that it would slide loose and the shovel would stay water wet.

As the tide would go out, the wind would tend to keep the oil pinned against the shore and the water would flow from beneath it, leaving most of the oil suspended at the latest high tide line. During the following hours, the oil so deposited would run back down the beach in stringers. This phenomenon of staying a narrow band of oil during high tide periods and a wider band of oil during low tide periods, led to some of the earlier beliefs that the oil was "going away", when in reality, most of the oil was remaining on the beach.

Figure 7 shows a typical uncontaminated beach in this stretch of the Straits of Magellan.

The beach zone typically consisted of a relatively shallow upper level near the spring tide high water mark, a steeper enbankment between spring high water mark and near the spring low water mark and then a broad shallow flat that was exposed only on the lowest, spring low tides. These shallow areas that were exposed during low tide were covered with rocks ranging in diameter from three to eight inches. Many of these would be coated with oil on the top very similar to milk chocolate icing on a cupcake. Oil would also be found floating in the water that had been trapped by the rocks when the tide went out. As will be discussed later, many marine organisms including mussels, limpets and starfish were found in these rocky intertidal areas.

FIGURE 7

TYPICAL UNCONTAMINATED BEACH

IN THE

STRAITS OF MAGELLAN

Assuming the oil/water ratios of five percent in the dark mousse and twenty-five percent in the milk chocolate mousse, it was estimated that approximately 50 pounds of oil was contained per cubic foot of the chocolate mousse (the chocolate mousse had a specific gravity of very close to one).

There were two minor estuaries which entered in the Narrows area of the Straits and it was observed that oil was carried a substantial distance, i.e. one mile or more, up each of these estuaries. The most easterly of the two estuaries appeared to be the most greatly affected.

During Monday, September 1, a very strong southwesterly wind blew almost in direct line with the centerline of the Narrows. This caused some of the chocolate mousse material on the beaches to be blown into the large bay to the east of the Narrows and on the flight made on September 4, it was observed that this material had been deposited on an approximately twenty-five mile stretch of the southern shore of the continent. This location is labeled Deposit B on Figure 2.

During the trip across the channel on September 2 and during the flight on September 4, large patches of darker oil appearing to be spreading faster than the chocolate mousse were observed on the water on the Narrows and to the east of the Narrows. It was later learned that an additional Bunker C tank had been ruptured prior to this period. When the wind shifted from the

southwest to the northwest on September 3, the darker, fresher oil was swept to the south shore of the Bay east of the Narrows and pooled just south of the Point Catalina. (Deposit C)

It was not possible to visit either of these two locations to observe the extent of the oil on the beach, although the extent of oil located east and west of Punta Posession appeared to be much smaller in magnitude than that located on Tierra del Fuego, whereas that pooled behind Point Catalina appeared to be a very wide "puddle".

Figure 8 shows two black and white photographs taken in the estuary which enters at Punta Espora, showing the deposits of oil on the shore. Colored photographs which show the oil deposits more vividly at a number of places along the coast are available in the author's files, and through the U.S. Coast Guard.

Samples of both the light and dark brown oil/water emulsions were collected for trans-shipment to the U.S. Coast Guard Research Center in Groton, Connecticut.

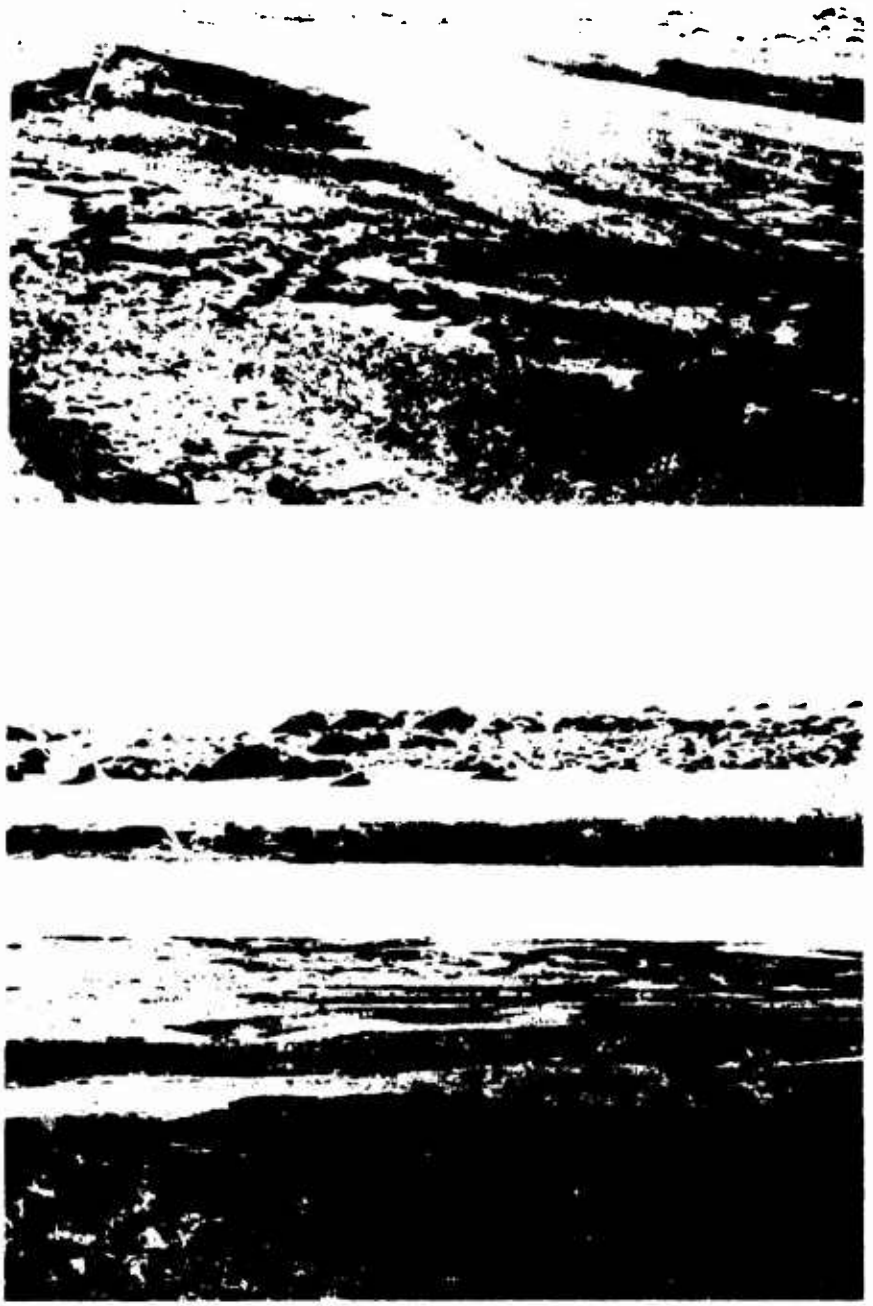


FIGURE 8

Oil On Shore of Estuary

SECTION III. IMPACT OF OIL ON THE SHORE

In the previous section, the magnitude of the oil deposition on the shore and the physical nature of the shoreline was described. The discussion of the impact of the oil on the shore is broken into three sections: (1) esthetics, (2) effects on marine organisms, effect on marine waterfowl, and (3) other impacts.

Esthetics:

The coastline of the Straits of Magellan in the vicinity of the Straits is very beautiful in that it consists of clean coarse sand beaches with occasional boulder strewn areas with occasional seaweed and liter strewn at the spring high tide mark. (See Figure 6) The rocky areas exposed during extreme low tides has a rich life of mussels, limpets, seaweed and other marine organisms. The waters were a beautiful greenish-blue. Above the spring tide high water mark, were brush grasses which at this time of the year were dormant.

Over much of the north shore of the Island of Tierra del Fuego, there are cliffs which arise from the beach line behind the spring high tide water mark a few feet behind the spring tide high water mark. These arise anywhere from a few feet to fifty feet in height. On the tops of the cliff are low straggly bushy cedar which grows to a height of about 18 inches in windy areas and to

a height of about 3 feet in sheltered areas. The cedar gives way to grasslands within a few hundred feet. The grasslands behind the beaches support sheep and cattle and the endangered guanaco, a llama like animal. Inland from the beach line and in protected areas are found shell middens which were left by the Indians which originally inhabited the Island of Tierra del Fuego, and who are the mussels and limpets from the tide flats. In one of these middens, a whalebone vertebrae was observed and in a number of others, and discarded spearhead were found.

Normal access to the Island of Tierra del Fuego is possible only by air or by ferry landings at Punta Espora near the middle of the Narrows and at the town of Porvenir some sixty miles to the west. Some tourism does occur, however, and the automobile club of Chile maintains a restaurant near the ferry at Punta Espora only a few yards from the oiled beaches.

The general citizenry of Chile did not appear to consider the north shore of Tierra del Fuego as a particular valuable environmental resource; possibly because of its remoteness; and possibly because of the other areas of extreme environmental beauty elsewhere in the province of Magallenes which is the southernmost state of Chile. The area does, however, possess a considerable amount of rugged beauty and charm and the presence of the guanaco and other species are of environmental significance.

TABLE 1

BIRDS OBSERVED TO BE AFFECTED BY OIL
ON THE SOUTH SHORE OF THE STRAITS OF MAGELLAN
BETWEEN PUNTA ANEGADA AND THE CENTER OF BAHIA FELIPE
August 30 - September 1, 1974

Scientific Name	Common Name (English)	(Spanish)
*Phalacrocorax atriceps	Blue-eyed Cormorant	Cormoran Imperial
*Phalacrocorax albiveuter	King Cormorant	Cormoran Imperial de las Malvinas
*Phalacrocorax magallanicus	Rock Cormorant	Cormoran de las Rocas

*Impossible often to identify species where covered with oil.

Speniscus magellanicus	Magellanic Penguin	Pinguino del Sur
Eudyptes crestatus	Rockhopper Penquin	Pinguino de Penaebo Amarillo
Larus dominicanus	Kelp Gull	Gaviota Dominicana
Larus Maculipennis	Brown-hooded Gull	Gaviota Caguil
Fulmarus glacisloides	Southern or Silver-Grey Fulmar	Petrel Plateado
Oceanites oceanicus	Wilgon's Storm Petrel	Golondrira del Mar Comieu
Polyborus plancus	Crested Caracara	Carancho
Diemedea melauophris	Black-browed Albatross	Albatross de Ceja Negra
Lophonetta specularioides	Crested Duck	Pato Juarjuae
Pelecauoides magellanicus	Magellaim Diving Petrel	Pato Yunco
Rollandia romand	White-tufted Grebe	Pimpollo

Also observed affected, but not killed by oil:

Undetermined species of plover,		
Probably Zonibyx modestus	Winter Plover	Chorlo Negro
Numenius Phaeopus	Whimbrel	Zarapito de Pico Curvado

The beauty, of course, has been degraded by the oil on the beach and no estimate of the recovery time to obtain to its original state is possible at this time.

Impact on Marine Waterfowl:

One of the major impacts of the spill is its affect on marine waterfowl. The species most affected by the oil are cormorants and penguins. Other birds found to be affected were gulls, albatross, petrels and ducks.

Figure 9 shows the three species of cormorants which were affected. The topmost cormorant is the rock cormorant, the second is the blue-eyed cormorant and the bottom one is the King cormorant. Approximately 150 dead cormorants were found during the initial survey.

Figure 10 shows a graph of the numbers of the dead birds found in each of the five mile segments of the field study. Subsequent correspondence from Chile indicates a marine patrol sent to the area by the Commander of the Third Naval Zone had found approximately twice as many dead birds as found on the initial survey.

Table 1 is a list of the scientific name, common name in English and common name in Spanish of the marine waterfowl in the area and of which one or more dead birds were found.

Particular concern was expressed for the penguin population which migrates from the Atlantic Ocean to three islands in the Straits of Magellan during September or early October for nesting and raising of their young. These three islands, Isla Magdalena,

FIGURE 9

Cormorants

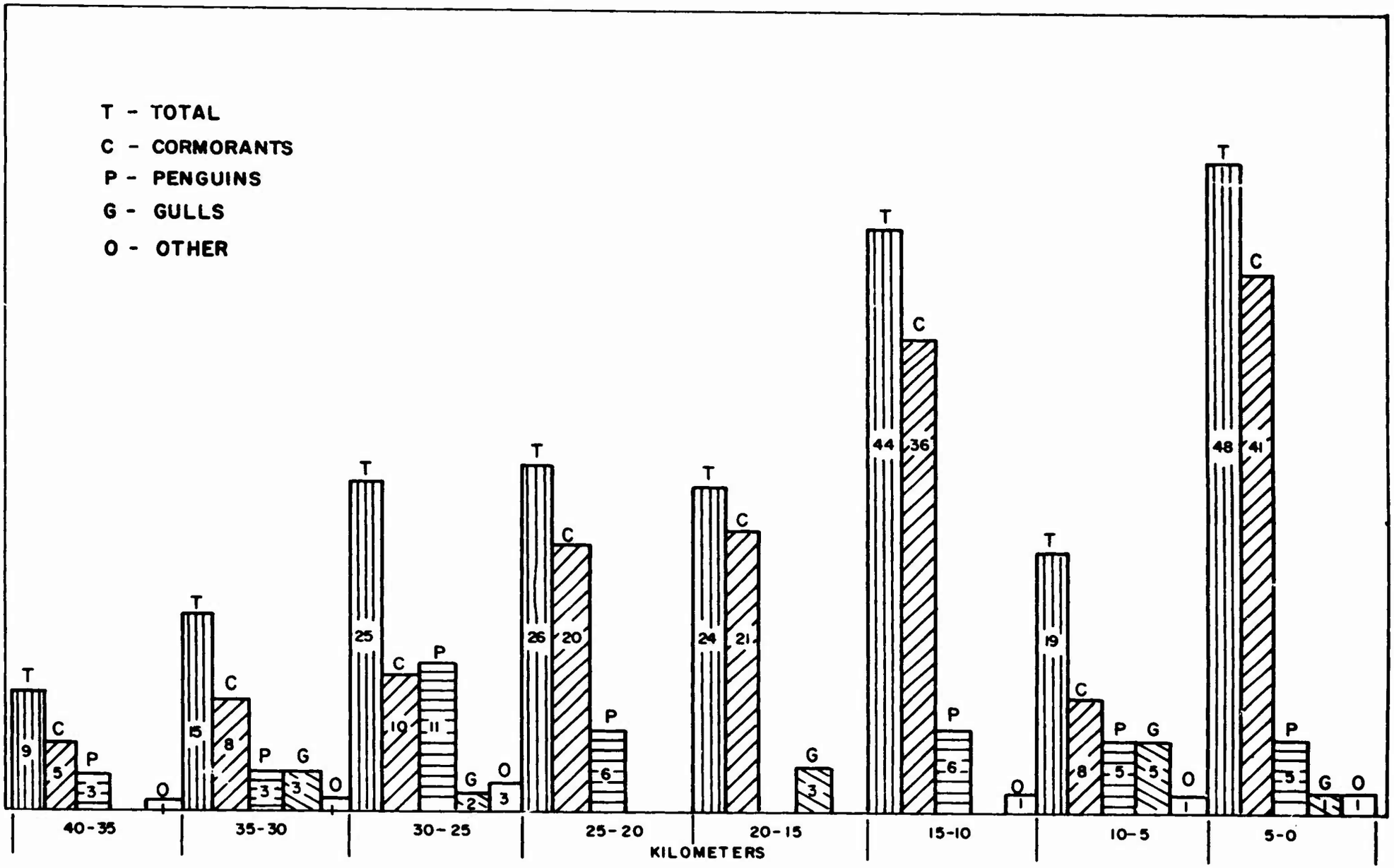


FIGURE 10

NUMBER OF DEAD BIRDS FOUND

Isla Marta and Isla Contramaestra form Los Pinguinos National Park in Chile. Two types of penguins are common to that area. The magellanic penguin sometimes referred to as the jackass penguin and the rock-hopper penguin.

Figure 11 shows a typical penguin from the local area. This penguin was less oiled than most of those found, but still is believed to have had his insulation waterproofing sufficiently destroyed so that he would not survive.

Impact on Marine Organisms:

The primary impact of marine organisms is expected to be in the broad littoral zone exposed by the twenty-foot spring tides. The beach zone exposed varied from a few hundred feet in the Narrows area to broad tidal areas of several miles to the east of the Narrows. As mentioned earlier, the rocky areas in the lower beach zone contain limpets, mussels, starfish and other aquatic organisms. The value of these organisms as a food in primitive times was demonstrated by the shell middens. Behind a number of the local habitations were found piles of the shells which remained after the shellfish were used as food. On two occasions, it was noted that octopus of about three inch diameter and with tentacles stretching to between 12 and 18 inches had crawled out of the oily water up onto the beach and in one case, an octopus was found on the top of a twenty-foot cliff where it had been carried by a bird.

FIGURE 11

Penguin

During the period of time that the onshore survey was being made, a group made a marine survey utilizing a vessel of the Chilean Fisheries Organization. This group did not find any deep water evidence of environmental impact in the form of dead fish, etc.

When samples of the light and dark chocolate mousse were brought back to the laboratory for analysis and the material diluted with salt and screened, a large number of worms and other organisms that had become entrapped in the oil were discovered. No attempt was made to identify the organisms.

The author was not able to estimate what impact was made on Phytoplankton and Zooplankton nor was it possible to estimate the secondary impact caused by the degradation in the Littoral Zone.

Recolonization will be difficult because of the climatic extremes, but may be aided by the high currents in the vicinity.

Economic Damage:

Minor economic damage has occurred in the vicinity of the ferry at Point Espora in that labor consisting of three or four men is required to clean off the ferry landing each day to permit the docking of the ferry from the north shore. It is understood that this work is being carried out by a local contractor with payment from the tank owners insurance company.

SECTION IV. COMMENTS REGARDING FEASIBILITY OF CONTAINMENT, CLEANUP OR STABILIZATION

At the time the author departed Punta Arenas on September 6, 1974, there had been no attempt to contain the oil leaving the tanker METULA, no attempt to apply dispersants or other chemicals to the oil in the water, and no attempt to remove or stabilize the oil on the beaches. There was at that time no stated intention to pursue cleanup operations, but there was a growing concern on the part of the local Chilean government over the continually increasing magnitude of the problem of additional oil released, the persistence of the oil on the water on the beaches and an increased awareness and concern over environmental matters particularly dealing with the upcoming penguin migration.

The purpose of this section of the report is neither to criticize nor defend the decisions reached with regard to containment, treatment or removal, but to explain some of the pertinent points which undoubtedly entered into the decision process of the people who were charged with making the appropriate decision.

1. Tides, Currents and Winds. This location on the Straits of Magellan is characterized by spring tides which range upward from 20 feet and neap tides of about three feet. The currents in the area of the Satellite Patch where the METULA went aground are on the order of 8 knots during spring tides. The winds in the area are consistently strong and westerly and probably averaged between 40 and 50 knots during the period of time that

the author was in the field. The presence of the high tidal ranges and currents is very similar to that found in The Forelands area of Cook Inlet, Alaska. The strong winds are unique to the Straits of Magellan. The presence of the strong winds and currents caused the oil which left the ship to move rather quickly at velocities that would have bypassed all containment equipment currently available. The high currents combined with gravity spreading the oil would have made it quite difficult to apply chemicals effectively to the oil because of the rapid movement and dispersion of the oils.

2. Shear Mass of the Problem. The loss of approximately 60,000 tons of oil creates a problem of gigantic proportions. If this volume of oil were contained, trans-shipped, cleaned up off the beaches and ultimately disposed of, large inventories of men and material would be necessary. In this remote part of the world, very little was available.

3. Myth that the Oil Would go to Sea. During the early days of the spill, the hope existed that most of the oil spilled in the Straits would be washed out into the Atlantic Ocean by winds and currents. This myth was supported to some extent by the aerial observations which noted that slicks that occurred from the massive spills seemed to "disappear", and by the fact that the magnitude of the oil deposit on the shore appeared to change from day to day when observed from the air. The knowledge of estuarine behavior and the phenomenon of oil spilled on water and

its behavior under current and wind conditions was not available in the area to permit better predictions to be made. In retrospect, the net movements of the currents is minimal and, perhaps, actually inland, as opposed to easterly to the Atlantic. Indeed, the westerly components of the wind would move the oil slicks to the east, but this would merely impact on the beaches of Tierra del Fuego and on the south edge of the continent as actually occurred. Undoubtedly, some modest quantities of oil did escape to the Atlantic, but it is believed that the greatest fraction by far resides on the shores of Tierra del Fuego and the Punta Posession area of the continent.

4. Minimization of Environmental Resources. The south shore of the Bay of San Felipe and the Narrows, which is the north shore of the Island of Tierra del Fuego did not appear to be considered a particularly valuable environmental resource by those dealing with the oil spill. This may well be because the local Chilean State (Magallanes) has many beautiful environmental areas and this shoreline may to them seem dull when compared to their other environmental resources.

5. Apparent Attitude of the Initial Advisors from the Tanker Owners and TOVALOP. The outside groups which arrived most quickly on the scene were the representatives of the tanker owners, the salvage operators and the representatives of the International TOVALOP Insurance Fund. From my viewpoint, some members of this group seemed to work quite strongly to "spread oil over the troubled waters of environmental concern" with both local government

authorities and with the scientists at the local Instituto de la Patagonia. Members of this group tended to voice quite loudly that there was "no pollution" because they did not consider damage to environmental resource to be of any value. It did not appear this group had gone to the impacted beach zone except for brief trips on the part of one or two individuals to the ferry crossing at Punta Espora. Members of the group tended to discount greatly the damage to marine waterfowl and when initial suggestions were made with regard to the possibility of a bird reclamation program, a story was circulated which reported that penguin eggs from the local penguin nesting grounds were sold in the restaurants in Punta Arenas and as long as this continued, they could not see the value of any worry about the penguins and other birdlife. When the story was later checked, it was found that this indeed had happened in times past, but since 1966 the nesting islands had been a national park in Chile and that such practices had been discontinued years ago. During a meeting between some members of the group and scientists at the local Instituto de la Patagonia, there appeared to be an attempt to play down the fears the scientists had with regard to environmental damage.

6. Lack of Logistical Support. The location of the spill on the Straits of Magellan is without doubt a very remote and desolate area. Almost everything that would have been necessary for control of the oil spill was lacking or totally non-available. For example, booms and barriers that could have been used for

containment if the currents permitted, were not available. Chemical dispersants and other chemicals which could have been used to disperse the oil if conditions permitted, were not available except for a few planeloads flown in weeks after the spill. Chemical applicators in the form of tugs, agitating equipment, etc. to apply chemicals were not available. Bulldozers, front-end loaders, dump trucks and other mechanized equipment to remove the oil from the beach were not available except for a small number used by ENAP. Indeed, the Island of Tierra del Fuego, which is south of the Straits which most of the oil impacted is very sparsely populated and the majority of the population is either involved with the local oil production through the Chilean National Petroleum Company (ENAP) or with cattle and sheep ranching. Even if adequate resources were located in Santiago and the Valpariso area, the country of Chile is extremely long and this would require between a 1500 and 2000 mile transportation by sea or air to bring these materials to the Island of Tierra del Fuego. The only connection that Tierra del Fuego has with the mainland is by two ferries, both of which are old World War II landing craft, which are already completely utilized by the existing commerce and business.

7. The Fear That Cleanup Would Cause More Damage Than the Oil. Inasmuch as the grouding of the METULA took place at 10:00 at night, it is evident that oil was on the beaches even before dawn the next morning. Thus, initial damage was done almost

immediately. There was concern that if major cleanup operations were scheduled on the beaches that perhaps more damage could be caused by the cleanup than would occur from the oil that was already on the beaches. This would include damage by mechanized equipment on the beaches, and the removal of marine organisms underneath the surface beach sand. It would particularly be true if detergents were used to attempt to wash the oil off the beaches back into the water, thus suspending substantially more oil in the water column than had occurred.

There was also concern that the removal of this tremendous quantity of oil to the inland areas could not help but cause additional environmental damage to the inland areas. This factor is not considered of great importance, however, because there are already some spoiling of land areas due to the production of oil by the ENAP Company.

8. Philosophy That Damage is Done. It was hoped that the oil already on the beach would go away in successive spring tides and be washed to the Atlantic. Since beach damage had already occurred, little harm was envisioned in allowing time to see if this would occur.

9. The Priority of Preventing Further Pollution by Concentrating on the Ship and Cargo. The greatest priority established by all concerned appeared to be that of preventing further pollution by the removal of oil from the strickened ship and by the salvage

and removal of the ship itself. This philosophy can really not be faulted because there still remained in the ship over three-fourths of its cargo which had the potential for release to the environment and very appropriately emphasis should have been placed on removing the source of the pollution, so that further pollution would cease to occur.

10. Lack of Time for Response. As mentioned in other sections above, the grounding took place within roughly one mile of the north shore of Bahia de Felipe and approximately three miles of the south shore. Thus, there was no reaction time available to local people before the oil reached shore. Indeed, much oil had already undoubtedly reached shore before the initial observation of the ship and local area were available early the next morning.

11. Lack of Technology and Trained People. There is quite evidently a grave lack of technology and trained people to both completely evaluate the nature of the problem and all possible alternatives and to carry out containment, treatment or cleanup operations. One recommendation which was made to the local administration was that consideration for cleanup be made in at least the local area near the ferry at Punta Espora in order to permit local personnel, very probably those of the ENAP Organization, to gain hands-on experience in the containment and removal of oil near the shore and on the shore. The local people appeared to have absolutely no knowledge of the technologies to carry out these operations.

12. Recommendations Regarding Containment and Treatment. As the spill progressed, several knowledgeable people arrived on the scene and a general agreement of these people was that booms, dispersants and surface tension agents would be ineffective in this situation. The booms were considered ineffective because of the currents and winds. The dispersants were considered ineffective because of the difficulty of application and mixing and surface tension agents were considered unusable because the oil was already on the shore and because daily application of the agents would have been required even if equipment were available. A single dispersant dispensing rig was made available through the British Warren Springs Laboratory and was tested using a fishing boat in the harbor at Punta Arenas. Beach cleanup was technically feasible and technology for cleanup available.

13. Difficulty of Access to the Beach Zone. The field survey on foot really emphasized how very poor is the access to the beach zone on Tierra del Fuego. It would be possible to get equipment to the beach only about every five miles. In other areas, there are cliffs ranging from a few feet tall to over 50 feet tall immediately behind the beaches.

14. Scarcity and Lack of Scientific Information. Throughout the study, it was evident there was a grave lack of scientific information with regard to the marine biological community. The marine biological program at the local Instituto de la Patagonia

and through the local fisheries agency had very limited information with regard to the species, habitats, etc. in the affected area. For example, it was almost three weeks after the spill occurred that information with regard to the pending penguin migration became available and concern was begun to be shown for the migration.

15. Other Factors. The author undoubtedly does not have access to the complete list of factors that were used in the decision process. Some of these may have revolved around the fact that the Chilean government owned the cargo and the effect of high cleanup costs on future insurance rates on cargoes shipped through the Straits. There undoubtedly were other factors of importance.

In summary, there were a wide range of factors to be taken into account in making decisions with regard to what to do with the oil after it had escaped into the environment. Frankly, it appears that in view of the economic stress of the country, the mass of the problem, the tremendous difficulty that would have been necessary to arrange logistical and manpower resources and the cost of these undertakings, coupled with the extreme climatical difficulties of the area, a decision to assess the situation, but defer cleanup was reached in the early stages of the spill.

It appeared from being on the scene that there were only two groups that could have effectively dealt with the spill. One, the Chilean National Oil Company, ENAP, which did have men and

materials, although somewhat limited on the Island of Tierra del Fuego. Although there appeared to be local interest on the Island for their involvement in the spill cleanup activities, this enthusiasm did not appear to be shared by their higher officers in Punta Arenas, who were reported as stating that their entire staff was completely occupied with their everyday business.

The second group which could have been mobilized was the Chilean Military. For whatever the reasons, the Chilean government elected to withhold military forces from cleanup efforts at this stage of the evolving incident.

SECTION V. LESSONS LEARNED FROM THE METULA SPILL

One of the major purposes to be served in sending the author to Chile to observe the fate and affect of oil from M/V METULA was to determine what lessons of importance could be learned from this incident which would be of value in considering supertanker and superport considerations in the United States. A number of these lessons are summarized below.

1. Spills Can Happen. Very Large Crude Carriers (VLCC's) and the superports to handle them are not designed with the intent of having oil spills, just like highways are not designed with the intent of having traffic accidents. However, it is realized in both of these cases that accidents will happen in time and the potential of an accident must be considered in determining the risk faced in handling this type of ship and in dealing with superports in general.

The spill volume from the METULA was at 51,500 tons of crude oil plus an undetermined amount of Bunker C. It was roughly four times the 15,000 tons that has been considered as the maximum credible accident for a collision involving supertankers in the Gulf of Mexico. This large oil loss does indicate that such larger spills can occur, even though it is likely that comparable damage would not have resulted in a comparable spill in the Gulf of Mexico because of the Gulf of Mexico's one foot tide as opposed to the 20 foot tidal range in the Straits of Magellan.

Similarly, it should be remembered that this size of spill is not restricted to supertankers, inasmuch as many tankers which are not in the supertanker or VLCC class carry 51,500 tons of oil which could conceivably be released in present waterways and in existing ports.

2. Ships are Vulnerable. It seems obvious to the untrained that ships which have single skins, single propulsion units, single screws and single rudders are designed primarily for the economy of the transportation of oil, and not for the safety and containment of the cargo. On that premise, accidents can be expected almost anytime and anyplace, either over the waterways these ships travel or at the port terminals where they receive or unload their cargo.

3. The Magnitude of the Problem is Huge. The release of 51,500 tons of crude oil plus an undetermined amount of Bunker C (i.e. approximately 16,500,000 gallons or 400,000 barrels) is a tremendous volume of oil and the subsequent coating of roughly 75 miles of coastline with an oil emulsion from 50 to 200 feet wide and one to four inches deep is a major problem. Many people still just don't realize how truly large a volume 50,000-60,000 tons of oil is.

4. Most Spill Control Methods Aimed at Small Spills. Many of the control techniques from start to finish involving booms, skimmers, dispersants, surface active agents, cleaning and hauling techniques, etc. are really aimed at spills that are much smaller than the METULA spill. For example, it would take a pretty good

size tanker just to haul enough detergent to Chile to have combined with the 60,000 tons of oil. Even under ideal mixing, it would have taken some 6,000 tons. Under poor mixing conditions, it could have been as large a volume as that of the oil spill. Other agents such as absorbents, etc., are just not designed for use with spills of this size.

5. Keeping Superports Offshore Helps Provide Reaction Time. The closeness of the METULA accident to shore emphasizes that when large supertankers come close to shore that the environmental resource can be damaged even before the people have a chance to go out and recognize that it is going to happen. Having superports sufficient distance offshore so that the one to two days travel time is provided before the oil could hit the beach, does provide time for the marshalling of equipment, and for the use of containment devices, detergents, etc.

6. Huge Amounts of Men and Materials are Required. It is considered that an average dump truck could haul about five tons of oil-water emulsion mixture, then it would require 12,000 dump truck loads to move the METULA oil from the beaches to the disposal areas. It is recognized that considerable sand, seaweed and other trash would have been picked up with the oil then the number would even be higher. Thus, you could not attempt to cleanup a spill the size of the METULA with one or two front-end loaders, a handful of dump trucks or a handful of vacuum trucks. It truly takes large amounts of equipment, access to the beaches, etc.

7. Need for Fast Mobilization and Trained People. Almost every training manual or document dealing with oil spills emphasizes the need for speed in dealing with the problem. The speed requires that a wide range of very competent people ranging from experts in salvage to cleanup to scientists be available to assess the damage and direct cleanup techniques. For a long period of time, from August 9 until the local and external personnel resources were assembled, much of the environmental damage had already occurred and that the number of options available was severely limited.

8. Thoughts on the Use of Detergents Should be Re-examined for Middlesize Offshore Spills. The toxic nature of detergents at the time of the Torrey Canyon Spill had generally led to the use of detergents as being frowned on for use in the United States. After seeing the impact of the oil on the shores in Chile, it is believed that the use of detergents for middlesized spills from offshore would generally be preferable to allowing the oil to come to the beaches, since present day detergents are much less toxic than those originally used. A substantial re-examination of the present philosophies should be instigated.

9. Port Location. Ports, particularly superports, should be located where cleanup is possible or else the risk of a spill without substantial cleanup must be accepted. In other words, one of the parameters which should determine the selection of sites for superports is the value of the environmental resource

which could be impacted and the expected effectiveness of cleanup operations on the exposed environmental resources.

10. Contingency Planning. Contingency planning with regard to oil spills should take into account spills of this size. If port facilities are built for supertankers in the United States, it is recommended that contingency plans which are required with regard to oil spills specifically show how a spill of the size of the METULA be physically handled.

11. Dollars in the Bank Doesn't Solve the Problem. It was quite evident in Chile that the availability of the TOVALOP funds did not solve the problems for Chile. If the funds cannot be transferred into men and material to cleanup the spill, they are not of much value.

12. Everything is Harder to do and Takes Longer in Remote Areas. Almost every activity in Chile appeared to take longer than it would in the United States. This included travel, customs, communications, etc. Planning for operations in remote areas will take almost a completely different type of thinking than that which would take place in the populated areas of the United States.

13. Local Scientific Capability Needs to be Utilized. To adequately evaluate the potential environmental harm in a remote area, it is necessary to find out about the local environment. Only local scientists can usually provide this information. Studies described in this report by the author could not have been carried

out without the personnel of the local Instituto de la Patagonia in Punta Arenas, Chile. The involvement of the Instituto de la Patagonia staff in providing information for the decision process in the latter stages of the METULA incident made for much more knowledgeable decisions.

14. Aerial Surveys are Very Valuable. Aerial surveys of the spill of the METULA proved to be extremely valuable to determine an over-review of the extent of the area affected, but they turned out to be grossly inadequate to give a detailed assessment to the problem. Only the field survey on the impacted beaches was able to determine: (a) the extent the sand was being blown over and into the oil, (b) the number of dead and oiled birds, (c) the depth of oil, (d) the deposits of oil above the tide lines, and (e) the full magnitude of the problem.

APPENDIX I. CHRONOLOGICAL REPORT OF TRIP

Saturday, August 24

Departed College Station at 4:00 p.m. for Houston to catch the 7:45 flight to Miami and, then, the 12:30 flight to Santiago, Chile.

Sunday, August 25

Arrived in Santiago and was met by Captain Switzer. Was advised to wait at the hotel for travel information. Later, was advised to leave at 9:00 a.m. Monday by commerical jet since the C130 was delayed for 24 hours.

Monday, August 26

Arrived Punta Arenas at noon. Was met by Commander Atkinson, who was not yet advised of my status or mission. Though the Chilean Government in Santiago had been advised of my role, my way had not been cleared with local naval commander Admiral Allen. Admiral Allen was concerned with large numbers of people arriving with various purposes and missions. Other Monday arrivals included Commodore Roland Enghahl, commander of the Swedish Coast Guard and Dr. Jon Wonhom of the British Warren Springs Laboratory representing IMCO.

In the evening, I had a chance meeting with Irving Barron, American Equipment Vendor, Peter Fassbender with the Chilean National Petroleum Company (ENAP) and Dr. Wonhom, which led to contact and

later meeting with Claudio Venegas, local biologist with the Instituto de la Patagonia, a local research organization. A meeting with the Instituto Director was set for the next morning.

Later met Mr. Wardley Smith of TOVALOP Insurance Group and Commodore Enghahl. I was advised of the space available on the Tuesday morning navy flight.

Tuesday, August 27

Missed the flyover when the guards at the airport would not pass Mr. Venegas, Dr. Wonhom or myself. Met with the Instituto Director Mateo Martinque and Dr. Edmundo Pisano regarding the possible role of the Instituto in assessing the impact of the oil spill.

Since an aerial survey was desirable to locate the extent of the oil on the shore and to evaluate the area for field program planning, arrangements were pursued through the Instituto to charter a small plane. Arrangements were finally made with the local Air Force Aero Club to charter a Piper Cherokee and appropriate police clearance for the flight was obtained. A joint sea-land field program was tentatively planned for Thursday.

Toured the facilities of the Instituto and reviewed stuffed collections of birds likely to be in the spill area.

Wednesday, August 28

Made an aerial survey with Dr. Wonhom and Mr. Venegas that covered the south shore of Bay Felipe, both shore of the First Narrows and the area eastward for about five miles.

Oil was observed on approximately 40 miles of beach. Photographs primarily color were taken of the beach zone and the ship.

Following the flight, the decision was made to separate the land portion and the sea portions of the field survey. Dr. Wonhom and myself were to join with William and Jean Texera and Claudio Venegas. Our departure was set for early Thursday morning.

Met with Commander Atkinson. He deemed it was appropriate to meet Admiral Allen the next morning, and a meeting was scheduled by Commander Atkinson.

Met strike team members who were departing for the METULA.

Thursday, August 29

Met with Admiral Allen and advised him of the details of the proposed field study and advised him I would coordinate any information, ideas or recommendations through Commander Atkinson. He was very cordial and appeared interested in receiving information and constructive comments.

Departed on field trip in the Instituto Landrover via Ferry (LCM) to Porvenir and by land to the ENAP Cerro Sombrero Petroleum Camp, where we were hosted by ENAP in a company apartment.

Friday, August 30

Following an extremely cold night and a 2 inch snowfall, we were plagued with car trouble and spent most of the day with the car in Manantiales. We were ungloriously towed back to Cerro Sombrero.

Made brief radio contact with the METULA and learned of first success of offloading to the HARVELLA. Radio contact was lost due to frequency change on the METULA.

Saturday, August 31

Were delivered to the Ferry Crossing at Punta Espora by ENAP. Jean Texera and I covered the beach zone about one mile west from the ferry landing and about one mile up the small estuary that enters at that point. Dr. Wonhom and Mr. Venegas covered about three miles east of the landing including the small estuary to the east. They were at or near Point Anegada.

Oil deposits were measured and pictures were taken of oil, oiled-live birds and dead birds. The temperature was 40°F and wind was approximately 50 knots. We were picked up by Bill Texera, patroled a one and one-half mile section west of Punta Espora and returned to Cerro Sombrero.

Sunday, September 1

Noting the strong westerly wind of 50 knots and 40°F weather, we planned the survey to have the wind at our backs. Dr. Wonhom and Mr. Venegas were dropped west of Punta Remo at a point 28 kilometers

from Manantiales. They proceeded eastward for approximately 13 kilometers where the landrover was left for them. Jean Texera and I proceeded eastward from the latter location to the zone west of Punta Espora covered the previous day. Bill Texera remained with the vehicle to facilitate pickup. We covered approximately 18 kilometers of beachline by dusk when we were met by the rest of the team and proceeded to Cerro Sombrero.

The beach was heavily coated over the 18 kilometer stretch and was reported heavily coated to the west by Dr. Wonhom and Mr. Venegas.

When downwind from the ship near Punta Bahia a strong petroleum odor was present.

Width and depths of oil deposits were measured or estimated and photographed. The presence of dead and oiled birds was regarded.

Some unusual impacts such as a dead fox, dead octopus and oil high on cliff tops were noted.

After completing the survey, we returned to Cerro Sombrero.

Monday, September 2

Reviewed the results of the surveys with Mario Mirando and Roberto Rayment, the ENAP Director and Assistance Director at Cerro Sombrero. We discussed cleanup methods, dispersants and oil burning.

We proceeded to Punta Espora in hope of taking the ferry. Weather prevented our crossing. We then spent the day collecting oil samples, summarizing data and observing local area. The extremely strong winds from approximately 240-250° at 50 knots and high spring tide was moving some oil out into Bahia Posession. Oil was pooling in the area behind Punta Espora.

To comply with the curfew, we returned to Manantiales for the evening.

Tuesday, September 3

Left Manantiales and proceeded to Punta Espora. The wind slackened to 10-15 knots from approximately 320-330°, moving some oil back westward and pooling oil on the south shore of the Narrows. We boarded the ferry (small LCMI) about noon. During the passage, we noted some patches of oil/water emulsion near shore and some darker fresher slicks near mid-channel. On the north side of the channel, we found more dead cormorants and an oiled penguin.

Wednesday, September 4

Briefed Commander Atkinson and Admiral Allen on results of our field survey. I arranged to accompany the naval flight on Thursday to observe any change on the beaches.

Proceeded to the Instituto de la Patagonia to package oil samples for shipment to the United States. These samples were later delivered to the Chilean Navy personnel for transport to Santiago and transshipment to the United States.

Thursday, September 5

The aerial survey with the Chilean Navy indicated oil still was on the beaches previously covered, but that deposits of oil/water emulsion were found from 5 miles west of Punta Posession to within two miles of Punta Dungenese. A large pool of darker oil that appeared to be a fresh slick was located west of Punta Catalina. This was later explained when the rupture of a Bunker C compartment was reported.

Spent the remainder of the day preparing the report requested by Admiral Allen.

Friday, September 6

Commander Atkinson and I met with Admiral Allen and presented a handwritten report summarizing the information learned on the field trip and during the over-flights. We departed early evening for Santiago.

Saturday, September 7

Met with U.S. Ambassador Popper, Captain Switzer and Commander Atkinson to report on trip activities. I then met with Captain Poisson of the Chilean Navy for the same purpose

Departed Santiago in the early evening for return to the U.S.A.

APPENDIX 2.

Letter Report to Admiral Eduardo Allen, Chilean Navy prior to departing Punta Arenas, Chile.

The letter was submitted in handwritten form on Friday, September 6, 1974.

TEXAS A&M UNIVERSITY
CIVIL ENGINEERING DEPARTMENT
COLLEGE STATION TEXAS 77843

ENVIRONMENTAL ENGINEERING AND ENVIRONMENTAL SCIENCE DIVISION

September 16, 1974

MEMORANDUM

TO: Admiral Allen

THROUGH: Commander Atkinson

FROM: Roy W. Hann, Jr.

SUBJECT: ENVIRONMENTAL ASPECTS OF THE "METULA" OIL DISCHARGES

The extent of oil discharged from the Tanker METULA was observed by air on August 28, 1974 and September 5, 1974 and by field survey with Instituto de la Patagonia staff and Dr. Wonhom (IMCO Representative of English Warren Springs Laboratory) on August 31, 1974 through September 9, 1974.

The field survey covered 25 miles (40 kilometers) from Punta Anegada to west of Punta Remo. Oil averaged 50 to 75 feet (18 to 25 meters) wide and 2 inches deep and consisted of a dark brown layer at and above the spring tide high water mark and a lighter brown layer at present high water mark. Some oil is covered by blown sand and rocky areas exposed by low tides (from 200 feet to 1/4 mile) have light brown oil on top of rocks.

The flight on September 5, 1974 indicates the area from Punta Piedra past Cabo Orange is heavily loaded as well as the zone between approximately Cabo Posession and Punta Dungenese (light brown oil emulsion) and westward from Punta Catalina (new black oil) approximately 75 miles (120 kilometers) affected. Some lighter loadings are apparent on south shore and in waters of Bahia Lomas and eastward from Punta Catalina.

A broad intertidal zone is affected by oil with immediate impact on mussels, limpets and other intertidal life and perhaps longer range foodchain effects on commercial species.

Over 200 dead birds were observed during the field study with cormorants (approximately 150) and penguins (approximately 40) predominating. Oil in water and on shore remains a hazard to waterfowl. Expected penguin migration (tens of thousands) is in danger.

It is my opinion that more oil is ashore than originally believed and that it will remain longer than expected.

Study of the impact and the recovery is recommended with the Instituto de la Patagonia playing a leading role. Have suggested study should center on 1) amounts of oil on shore, 2) study of penguin migration fate, including survey of resident population, and 3) study of inter-tidal organism fate and recovery. I will be pleased to support to degree feasible.

Clean up of the spill is possible, but difficult and expensive due to location, weather, terrain, tide conditions and logistics. For example, only two ferries connect the Mainland to Tierra del Fuego and they are tide and weather limited and already busy. If clean up attempted, initial action is recommended on shores of narrows and westward.

Samples of oil on the beach have been collected for shipment via the U.S. Embassy to United States Coast Guard Research and Development Program Center, Groton, Connecticut.

Crude oil samples have been requested of Commander Park. If these are not forthcoming by September 7, 1974 suggest Admiral Allen order their collection and subsequent shipment to the U.S. Coast Guard.

It is believed knowledge gained from observing the "METULA" spill will be of considerable value to the United States Government. Assistance in helping accomplish my mission deeply appreciated. I thank you and your staff for the kind hospitality.

Roy W. Hann, Jr.

APPENDIX 3. PERSONS CONCERNED WITH METULA SPILL, PUNTA ARENAS, CHILE

Governmental Agencies

Chile Navy	Contra Almirande Eduardo Allen Commodore 3rd Naval Zone
Instituto de la Patagonia	Mateo Martinique, Director
	Edmundo Pisano, Head of National Resources Department
	William Texera, Zoology Department
	Jean Jory Texera, Ornithologist
	Claudio Venegas, Ornithologist
	Italo Campodonico, Marine Biologist
	Leonardo Guzman, Marine Biologist
ENAP (Chilean National Oil Co.)	Eduardo Gonzales, Director-Administrator
	Peter Fassbender, Drilling Engineer
	Mario Mirando, Director, Cerro Sombrero
	Roberto Rayment, Assistant Administrator, Cerro Sombrero
IFPO (Instituto de Fomento Pesquero)	Alfredo Sanhueza
USCG	Commander James Atkinson
	LT. CMDR. Bill Park, Gulf Strike Team
	LT. CMDR. Weichert, Pacific Strike Team
Swedish Coast Guard	Commodore Roland Enghahl
IMCO	Dr. Jon Wonhom, English Warren Springs Laboratory

Pollution Aspects of Spill

Shell International Marine	Mr. John Butt Captain Rod Brown, Laisson Office
TOVALOP (Tanker Owner Voluntary Assoc.)	Mr. Wardley Smith, Oil Pollution
P & I Clubs (Underwriters)	Rex Palmer
Local Shell Agent Products	R. Gibbons
Ultramar (Local Maritime Firm)	P. Fussel

Salvage

Schmidt & Company	Mr. Colthoff, Salvage Master
Shell Tanker BV Rotterdam	Captain D. Jongerneel
Shell International Marine, London	Captain N. Jolviet
Metula Captain	Captain F. Minkels

APPENDIX 4. BROCHURE OF THE INSTITUTO DE LA PATAGONIA

INSTITUTE OF PATAGONIA

The Institute of Patagonia is a center for studies and investigations which was founded the 2nd of March of 1969, with the object of contributing to scientific knowledge and to the cultural, social and economic development of Chilean Patagonia and adjacent regions.

It is divided into two large areas of work, one, of basic investigation and the other of applied investigation and experimentation.

In the first area falls the Department of History and Geography with sections in History, Geography and Archeology and Anthropology, faculties which have the purpose of studying human events in the past and, in this case, acquiring a better knowledge of the physical aspects of the region. Besides, there is the Department of Natural Resources with its sections of Botany, Zoology and Hydrobiology, whose objectives are to pursue the scientific knowledge encompassed in the ecosystems in the extreme American south and by the varied biota that inhabit them.

In the area of applied investigation and experimentation are located the Center of Experimentation and Development of Craftsmanship, with its studios in Ceramics, Wood Carving and Weaving, and its faculty of investigation that searches out the creation of a typical craftsmanship of the region with indigenous roots

with regard to motivation and design, and using materials from Magallanes itself. Also located in this area is the Center of Experimentation in Horticulture and Floriculture, which has for objectives the testing and adaptation of varieties of vegetables and flowers cultivated under glass and in the open air, with designs of encouraging a regional horticulture, bettering its technology and increasing, consequently, its productivity and production.

The Institute owes its being to and works for the community where it is located and tries to publicize the results of its various scientific works by means of conferences, periodical courses and seminars, permanent displays, expositions, and publications.

Finally, it depends on the Magallanes (Magellan) Foundation which is a private, non-profit organization that concentrates its funds on public works. The offices, studios, laboratories and other installations of the Institute are located on a campus of an area of 12 hectares, which is located near Avenue Presidente Bulnes, 4 kilometers from the City of Punta Arenas.

MAGALLANES

The Provice of Magallanes has an area of 132,033.5 square kilometers, which makes it the largest of the Chilean provinces. On it also depends administratively the Chilean Antarctic Territory, which covers an area of 1,250,000 square kilometers.

Such a vast area -- which is referred to as the American part -- occupies the southern portion of Patagonia, the central-western section of Tierra del Fuego and the Patagonian and Fuegan archipelagos. The Andes Mountain range which crosses from the north down toward the southeast divides it into two very dissimilar regions. One, the western slope, is the singular world of the archipelago characterized by the abrupt orography and the domain of mists and glaciers, region of a pristine, natural life where humans are found lacking. The other, on the other hand, the eastern slope, is an area whose smooth slope descends gently toward the Atlantic, characterized by the immensity of the Patagonian Steppe, a region where human life is located, where in fact all the provincial economic activity is developed.

The most outstanding natural and economic resources of Magallanes are sheep -- of which the region possesses 50% of the natural total -- being important in addition to the bovine population in the pre-cordilleran terrains; petroleum and natural gas, of which the Province is the only producer in the country; as well as the resources of the forests, minerals -- in particular the coals and calcium carbonate --, fishing and tourists, So many resources allow the existence of an industrial infrastructure destined to be exploited and transformed.

Magallanes has a population slightly more than 100,000 inhabitants -- this is a little more than 1% of the total population in Chile; this population, however, is a product of national emigration

particularly from Chiloé, and of European immigration, mainly from Yugoslavia and Spain, occurring between 1880 and 1920. The capital and principal urban and economic center of southern Patagonia is Punta Arenas (population 70,000) founded the 18th of December of 1848. Other centers of life are Puerto Natales, in Última Esperanza (Last Hope), Puerto Edén, on the Patagonian channels, Bernardo O'Higgins, on the eastern pampas, Porvenir and Cerro Sombrero, on the island of Tierra del Fuego, and Puerto (Port) Williams, on the Islas Australes (Southern Islands), the most southernly point on the globe that is inhabited by humans.

The Fuego-Patagonian region -- and consequently Chile throughout the south -- were discovered by Ferdinand Magellan the list of November of 1520 and incorporated under the jurisdiction of the Chilean Government in 1555. The effective occupation occurred in 1843, an era in which there was the start of national colonization in the Patagonian and southern lands.

Translated from Spanish.

APPENDIX 5. INFORMATION ON LOS PINGÜINOS NATIONAL PARK

National Park

"LOS PINGÜINOS"

(The Penguins)

97 hectares Strait of Magellan

-- It is also of small size, 97 hectares. It includes the small islands of Marta and Magdalena, located in the Strait of Magellan, to the south of Segunda Angostura (Second Narrow). As in previous times, its principal purpose is the protection of the rich marine avifauna which nest in this territory, for which it is also classified as a Sanctuary for Forest Life.

These islands, also located in the territory of the Patagonian Steppe, are formed by a gross moraine sediment of quaternary origin, modified more or less intensely by fluvial processes and which lies over a dioritic substrate. These characteristics make its coasts abrupt and steep due to the effects of marine erosion.

As with the National Park "Laguna de los Cisnes" ("Lagoon of the Swans"), its natural vegetation is very strongly altered by the effects of the nesting birds. This situation has become extreme on the island of Marta, which, due to the lack of vegetation, presents an aspect that is totally desert-like.

Translated from Spanish.